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AMERICAN AND EUROPEAN MICROSCOPES.

Extract from an address delivered before the A. S. M. on "What I Saw in the Optical Establishments of Germany."]

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Last year at the meeting of the A. S. M. in Pittsburgh (1887), I had occasion to make some remarks concerning an examination of a new Zeiss apochromatic $\frac{1}{12}$ inch homogeneous immersion objective, N. A. 1.40, and its workings with its compensating and projecting eye-pieces. I compared its performance by central and oblique light on test objects and on bacteria, etc., with that of some of our best American objectives, but particularly with a $\frac{1}{15}$ inch homogeneous immersion objective of Tolles, N. A. 1.30. The conclusions arrived at I expressed in the following words: "I am convinced that the apochromatic objective examined in no way surpasses the best work (objectives) of our best American makers." This sentence evoked considerable discussion. I therefore offered to back my statement with facts; to photograph *Amphipleura pellucida* with oblique, and bacteria with central light, with American objectives and American accessories, and challenged my opponents to produce as good or better work with European apochromatic objectives, if they could. I made this offer because photomicrography, it must be admitted, constitutes the crucial test for perfect achromatism, and hence for the very quality in which the new apochromatic objectives are claimed to be superior to all others. I have done what I promised, have made the photomicrographs of *Amphipleura pellucida* and of several bacteria

—amplification 1120 and 692 diameters respectively — and hand them to the members of the Society for inspection.

Since the Pittsburgh meeting I have made a trip to Germany, from whence I returned only last week. In Germany I visited three of the principal optical establishments of that country, namely, those of Ernst Leitz in Wetzlar, of Seibert & Seibert in Wetzlar, and of Dr. Carl Zeiss in Jena. I stopped one day in Wetzlar and one day in Jena. The proprietors of all three establishments received me with great kindness, and very courteously showed me their fine work. I had some test objects with me, some balsam-mounted *Amphipleuras* from Lake Nippersink and from Lake Pistakee, objects which my American homogeneous immersion objectives, a $\frac{1}{10}$ inch Spencer, N. A. 1.38, and a $\frac{1}{15}$ inch (in reality a $\frac{1}{16}$) Tolles, N. A. 1.30 will resolve with and without sub-stage accessories, with comparative ease by lamp-light. These test objects I showed to Mr. Ernst Leitz, to Mr. Seibert, and to Dr. Roderick Zeiss. They all examined but failed to resolve them. Of course they themselves handled their own instruments, and although they did not succeed in showing the lines, I saw enough to become convinced that the objectives of either one of these renowned makers would have resolved the tests with a little skillful manipulation. I have no doubt that I could have shown them myself, but not being asked to do so I did not feel called upon to ask the opticians to let me manage their instruments, and so the test objects were shown but not resolved. I also showed bromide prints and lantern slides (transparencies) of my photographs of *Amphipleura pellucida* (magnified 1120 and 692 diameters) and of *Bacillus anthracis*, *Bacillus tuberculosis*, Dr. Koch's Comma bacillus, my *Bacillus suis*, and several others (taken from the same negatives as those now in your hands for inspection), and all three opticians admitted that they were good, and that my photographs of *Amphipleura* were the best they had ever seen. Dr. Roderick Zeiss was kind enough to

exchange some of his photographs of *Amphipleura* for mine, and as I have them here with me, I lay them before you so that you may judge for yourselves. For further comparison I will also show you some photographs of *Amphipleura* made in Dr. Koch's laboratory, and one made by Dr. Neuhaus, an expert in photomicrography. I only have to remark that mine have been made by lamp-light, and the others by sunlight, and with the aid of a heliostat. Dr. Zeiss's photographs have been made with his apochromatic $\frac{1}{12}$ inch homogeneous immersion objectives, N. A. 1.30, his No. 2 projection eye-piece, a very ingenious, complicated, and costly camera, and an illuminating apparatus composed of an Abbe homogeneous immersion condenser, N. A. 1.40, and several condensing lenses. A light-filter was also used. In Dr. Koch's laboratory the same appliances are in use. My photographs, on the other hand, have been made in a very simple way, which I shall have an opportunity to show and to explain tomorrow or next day. The appliances used by me consist of a Spencer $\frac{1}{16}$ inch homogeneous immersion objective, N. A. 1.38, a common Huyghenian eye-piece (a No. 2 for the higher, and a No. 1 for the lower amplification), a Bulloch "Professional" microscope stand, a common Blair camera, a coal-oil lamp worth fifty cents, and a condensing apparatus, composed of a medium-sized bull's-eye condenser made by Bausch & Lomb, and an Abbe condenser made by Bulloch. The frustules photographed by Dr. Zeiss and in Dr. Koch's laboratory were mounted in a medium of a refractive index of 2.40 (Stannic chloride), and those photographed by me in a medium of which I do not know the composition and the refractive index, but which probably is not higher than 2 or thereabout. My photographs, and also that made by Dr. Neuhaus, are perfectly free from diffraction lines, while those of Dr. Zeiss and Dr. Koch are not.

As to stands, the Germans yet adhere to their old low and chubby models, and most of them use their microscopes

in a perpendicular position. They, however, are becoming aware of the inefficiencies of their small stands with hardly any room above or below the stage, but instead of departing from their old pet models, they rather devise very ingenious and complicated accessories to remedy the defects, and what they save in the cheapness and simplicity of their stands they spend three and four times over in their accessories, particularly in such as are required on account of the insufficient adaptability of their stands in accurate microscopic work with high powers, and in photomicrography. Some of the German opticians, for instance Dr. Carl Zeiss, who is the most progressive, begin to adopt American ideas and improvements, especially in regard to mechanical movements of stage and substage, iris-diaphragms, etc.

In conclusion I must say again, I am more than ever convinced that the *renowned apochromatic objectives of Germany, with all their recognized excellence and improvements, in no way surpass in their performance the best objectives of our best American makers.* In at least one respect our first-class American homogeneous immersion objectives are preferable. They have collar correction, which is not found in any of the apochromatic homogeneous immersion objectives of German opticians. Our American objectives, therefore, are adapted to a larger range of work, and can be used with any tube-length, while the German apochromatics can not. Still, the latter, it seems to me, are not quite so sensitive to tube-length as is claimed. Further, the German apochromatic homogeneous immersion objectives are more expensive than our American objectives of corresponding quality. So, for instance, apochromatic homogeneous immersion objectives of Zeiss are offered in Jena: a $\frac{1}{8}$ inch N. A. 1.30 for 450 marks, or about \$110; a $\frac{1}{8}$ inch N. A. 1.40 for 550 marks, or about \$135; a $\frac{1}{12}$ inch N. A. 1.30 for 400 marks, or a little less than \$100; and a $\frac{1}{12}$ inch N. A. 1.40 for 500 marks, or almost \$125; while Bausch & Lomb Optical Co., and H. R.

Spencer offer their homogeneous immersion objectives, N. A. 1.40 and 1.38 respectively, at from 40 to 80 per cent. less, as their catalogues will show.

I have here with me an excellent apochromatic homogeneous immersion $\frac{1}{12}$ inch N. A. 1.35, made by E. Leitz in Wetzlar, which comes here, duty included, at about \$109. I offer it for inspection and comparison. It is without collar correction, but is otherwise about as good an objective as I have seen in Germany. With a common Huyghenian eye-piece it gives an image as free from color as can be desired, but not a very flat field. With its compensating eye-piece, I expect the field would be flatter. Still everyone may judge for himself.

A few words yet in regard to an article by Prof. Charles Sedgwick Minot, which was copied by nearly every microscopical journal, and in which microscopes of German and French manufacture are extolled as the only ones worth having, and those of American make pronounced worthless. One who will thus run down American microscopes and objectives either does not know the first-class work of our best American opticians, and has been so unfortunate as to get into his hands nothing but inferior work of some irresponsible men, or he doesn't know what he is talking about, unless it be that he has an axe to grind, and wants to import cheap European instruments, or has written for political purposes in support of free trade. Still, old prejudices die hard, particularly, it seems, in Harvard University. For many years the foremost optician in the world, the man who made the best objectives that were made, and did as much for the improvement of the microscope as anybody, if not more—I do not need to say that I mean Robert B. Tolles—lived and worked in the immediate neighborhood of the old University, and never found recognition by any of the professors, with one exception, that of a gentleman well known to all of you. But such is life. There are people

who look in the distance for what they have before their face but do not see.

Under the date of October 3, 1888, Dr. Detmers wrote protesting against the incorrect reports of his address before the Society upon the German optical establishments, and in contradiction to the statements published in various journals said: "In the first place I did not take my microscope, objectives, or other accessories with me to Europe, nor did I say I did. Secondly, there was no microscopical tournament or test of skill between any German optician and myself, nor was there any photographing done in my presence, except in Dr. Koch's laboratory in Berlin. The photographs made by me, which I showed at the meeting of the American Society of Microscopists, were made last fall, last winter, and last spring, consequently long before I went to Europe; and the German photographs which were given to me in exchange for mine were not made in my presence, but finished and in the same condition in which I exhibited them to the Society. Thirdly, I have never in any way said anything derogatory of, or against, the optical work of German opticians; on the contrary I recognize the excellence of their objectives. What I said was, in their performance the German apochromatic objectives are *not superior* to the best work of our best American makers, notwithstanding the new glass. As to microscope stands, I claim decided superiority for those of American make."

— SECRETARY.